Toward Electronic Health Records

Office of Health and the Information Highway
Health Canada

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EXECUTIVE SUMMARY

The Advisory Council on Health Infostructure identified the electronic health record (EHR) to be of pivotal importance to an integrated health care delivery system. It is the means by which patient-centred health care delivery can be achieved. As such, the EHR is a key priority for Health Canada as a key element of a Canadian health infostructure.

The objective of this report is to examine the potential role of EHR systems within the Canadian health care delivery system and to identify a course of action for the Office of Health and the Information Highway (OHIH).

Canadian jurisdictions as well as other countries have recognized the need for EHR systems; this is demonstrated by the number of EHR-related initiatives under way across Canada and internationally. However, it is also recognized that any implementation of EHR systems is a complex long-term and very expensive undertaking. To capture the results of health-related encounters that occur every day between patients and health care providers in a format that allows for the access to that data by the appropriate people will require the cooperation and close interaction of all stakeholders.

Changes within the health care system, society and the increasing power of technology are putting pressure on governments, health care providers and decision makers to implement EHR systems. The health care system itself is going through some dramatic shifts with health services now being centralized at the community level across the health delivery spectrum of primary, acute and community/home care. As provinces are delegating more authority to regions, there is a requirement that service delivery be integrated in a cost-effective manner.

At the same time, Canadians are demanding a greater voice and want to play a larger role in their health care. They want to be in a knowledgeable position to be able to participate in decisions being made that will affect their health. This will require access to their health data as well as associated health information. Technological capabilities are expanding at a great rate and their associated costs are decreasing. Perhaps just as importantly, there is increasing acceptance of technology by health care providers and the public in general. All of these factors are contributing to the adoption of a nationally interoperable EHR system.

The foundation of an EHR is electronic patient records (EPR) which represent the results of a series of encounters between an individual and a health-related encounter. EHR systems are composed of all lifelong EPR records for that individual incorporating data from all sources: health care providers (e.g. physicians, hospitals, community and home care), as well as support and feeder systems (e.g. pharmacies and laboratories). An EHR system would make the data available to

health care professionals anywhere on a need-to-know basis by connecting interoperable databases that have adopted required data and technical standards. The patient would retain control over who gets what information when, and for what purpose. Stringent measures would be built in to safeguard patient privacy and confidentiality.

The implementation of EHR systems is not simple: it will involve a long-term, highly coordinated commitment from a large number of stakeholders and a significant financial investment. No known EHR-related initiative is trying to implement a total health care solution. To this end, projects are under way that address part of the puzzle (i.e. pharmaceutical systems), others are developing application models (emergency health records) on which to base further development, and still other projects are using technology models such as Smart Cards. Some sample projects follow.

- The United Kingdom is investing more than approximately $2.5 billion over seven years on a clinical solution.
- Jurisdictions within Canada have initiated projects with EHR components, such as HealthNet/BC, Alberta We//net and Ontario's Smart System.
- Health Canada's First Nations Health Information System (FNHIS) provides a comprehensive, flexible and powerful platform for case management and evidence-based planning and decision making for Canadian Aboriginal people.
- The Health Care Coordination Initiative (HCCI), composed of several federal departments and agencies with responsibilities for health care delivery to specific populations, has recognized the importance of a Canadian health infostructure, and supports the leadership role of Health Canada with regard to federal government health information needs.
- The Department of National Defence and Correctional Service Canada are currently involved in the development of EHR systems.
- Internationally, several countries such as Italy, France and Germany, to name a few, have EHR-related initiatives under way.

To be effective, benefits for all of the stakeholders involved in implementing EHR systems must be realized. Some of these expected benefits include:

- support patient care and improve its quality;
- enhance productivity of health care professionals and reduce the administrative costs associated with health care delivery and financing;
- support clinical, epidemiologic and health administration research;
- accommodate future developments in health care technology, policy, management and finance; and
- provide improved confidentiality and security for all health-related data and information.

There are many challenges to build a system of the size and complexity of a national EHR system. The number of stakeholders and organizations is very large and their needs and priorities different. Capturing their support will be essential to build successful EHR systems. The responsibility for

the delivery of various aspects of health care delivery varies between each province and territory and with each of these jurisdictions taking different approaches to governance. Standards are required not only for the EHR data but also as they relate to the technology infostructure. Policies must be developed for privacy, confidentiality and security. Finally, a key challenge will be capturing the large volumes of health data generated on an ongoing basis. It is estimated that there are over three million health-related transactions a day.

Activities are currently under way across Canada, and a common vision would set the stage for a nationally interoperable EHR system that would pull health information together, and overcome the challenges posed by geography and the multitude of information systems that currently exist in Canada's health care system. It must be recognized that as these projects evolve, there is a need to identify and implement standards and policies which will ensure that the resulting systems will be able to interact with each other and share their data.

Leadership is required to establish a shared vision and a shared commitment toward the achievement of this common vision of a national EHR system. Key stakeholders must be made aware of and buy into the promotion of this vision as well as the establishment and maintenance of the infostructure elements required to implement and sustain the system into the future.

To facilitate the movement toward an EHR, it is important that the Office of Health and the Information Highway take an active and collaborative approach to work with key health care stakeholders, government departments and federal/provincial/territorial (F/T/P) committees. Six key components of this collaboration have been identified.

Promote and champion the role of EHR systems.

1. Maintain and disseminate up-to-date knowledge of EHR initiatives.
2. Forecast future technology advances as they relate to EHR projects.
3. Provide funding programs related to EHR projects.
4. Identify and develop key policies and principles for the development of EHR systems.
5. Facilitate the development of an evaluation framework to measure the success of EHR projects in a consistent fashion.

BACKGROUND

In its 1999 final report, *Canada Health Infoway: Paths to Better Health*, the Advisory Council on Health Infostructure recognized that "the Canada Health Infoway will become the key information and communications foundation for our health care system in the 21st century."(1) To support this national "infoway," the Advisory Council identified two key components, the EHR and telehealth. The report states, "Patient-based health records are fundamental to provincial and territorial health infrastructures." In recognizing the importance of privacy, the Advisory Council "believes that, with particular care, electronic health records can actually enhance privacy protection, empower citizens through greater control of their own health records . . . ." (1)

The importance of a health "information highway" to Canada's future development and to its global competitiveness was recognized by premiers and territorial leaders at the Annual Premiers Conference held in Québec City in August 1999. In support of the information highway, the leaders agreed that:

> *Information to support timely decision making is important at all levels of the health care system. Most importantly, enhanced information systems have direct applications in patient care and improved health system management. (2)*

The purpose of this document is to provide a consistent understanding and basis for discussion of EPRs and EHRs for the staff of OHIH to propose an OHIH strategy for action, and to provide a summary of related information. This report is intended to support OHIH staff in developing a strategy and supporting activities to help develop a national EHR system. It is felt that, in the longer term, this report will evolve and have several iterations as new EHR information becomes available, initiatives occur and as development of the health information structure advances across Canada.

The report has been developed from the combined efforts of OHIH divisions and led by the Infostructure Systems Management Division (ISMD). The material was gleaned from various publications, papers, conferences, Web sites and through discussions with staff and people knowledgeable in the field.

This document begins by presenting the influences that support the creation of an EHR and moves on to assist the understanding of EHRs by developing a definition and reviewing the components of the record. Approaches to implementing EHRs and related Canadian and international initiatives are identified, as well as the challenges to be faced in creating a national EHR system. The final section proposes an OHIH approach for advancing EHRs within the Canadian health infostructure.

Throughout the document, numeric references appear that refer to sources listed in the Annotated References found at the end of this document.

Overview of an Electronic Health Record

All provinces and territories in Canada have recognized the need for health infostructure development and have undertaken EHR-related projects. In addition, numerous international initiatives are being conducted in the United States, United Kingdom and European Union countries, to name a few.

Even though it is recognized that these projects are resource intensive, it is believed that the expected benefits will outweigh the costs. EHRs will provide health care professionals with access, on a need-to-know basis, to an individual's health records. For example, access to such things as test results and a list of prescribed medications will assist health care professionals in making better decisions based on a patient's medical history. Canadians will have access to their own medical history, allowing them to work with their health care providers to make better informed decisions on their own health care. Health care administrators, policymakers and researchers will have access to the required data to evaluate and strengthen the health care system through better integrated health care information.

However, the development and implementation of EHRs is no simple matter. The health care system is enormous, involving millions of encounters between patients and health professionals every day. In 1994–95, there were 3.5 million hospital discharges from general and allied special hospitals in Canada. The number of some of the providers illustrates the size and complexity of the system:

- over 800 hospitals involving some 123 000 in-patient beds (1998);
- more than 28 000 general practitioners and 27 000 medical specialists (1997);
- approximately 230 000 registered nurses in addition to nursing assistants; and
- more than 9 000 pharmacists, 6 000 occupational therapists and 9 000 physiotherapists.

As a result, the implementation of an EHR system is very costly, long-term initiative. For example, the National Health Service's project in the United Kingdom is estimated to cost $2.5 billion over a seven-year period, and the Smart System project in Ontario has allocated $550 to $700 million over the first three years of the project.

Taking the vast amount of health information accumulated for Canadians over their lifetimes and placing it within a structure that facilitates its extraction in an accurate, user-friendly, appropriate, timely and secure fashion is an immense undertaking. Currently, an individual's health data are spread over many health care providers (e.g. physicians, hospitals, pharmacies), in many locations and in many formats. Another level of complexity is provided by the various provincial and territorial approaches to delivering health care. To illustrate how a new structure might use the historical information already collected over the past years, two options are presented. The first would be to insert past data into an infrastructure that will also accommodate future data in a compatible and interoperable manner. This will require extensive coordination from data,

application and technical perspectives. Alternatively, a specific point in time can be identified after which only newly generated health data will be captured and the historical data retained in its current medium. Both options require the establishment of consistent standards and privacy legislation.

This overview is intended to make the reader aware of the potential benefits and challenges envisioned to implement an EHR system across Canada. The following sections will delve into further details and provide a broader picture of these benefits and challenges.

Factors Influencing the Movement Toward Electronic Health Records

A number of factors have emerged over the past several years and have led to increased attention toward adopting EHRs. While many factors are technological in nature, changes in health care delivery and consumer expectations will also be influential in determining the adoption of EHRs.

Changes in health care delivery

- More and more Canadians are expressing an interest in playing a greater role in decisions regarding the health care services they receive. Having access to their own EHR will assist in this process by providing individuals with a comprehensive picture of their own health file.

- The shift away from institutions to community-based services has meant that Canadians and their provincial/territorial health care systems are increasingly relying on a wider range of health care professionals (e.g. nurse practitioners, physiotherapists, midwives, dietitians) and locations (out-patient clinic, home, group residence) for their care. There has also been an increase in accessing medical specialists. The result for patients is that they may be cared for by several providers—all of whom will require information about the patient, such as through EHRs, to ensure the highest quality care possible.

- Health care reform across Canada has created significant changes in how health care delivery is organized. Foremost is the move to regional health boards that are responsible for funding and overseeing how most health care services are delivered in their respective regions. One of the emerging goals of regionalization is a more integrated approach to delivering care since many services are now governed by a single board. A major element of such an integrated approach is to provide better care through the sharing of the patient's information among all necessary health care providers. This can be achieved only by better information systems, including the use of EHRs.

- Canadians, governments and other health care funders are demanding a more accountable health care system. The information available from EHRs (in non-identifiable or aggregate form) can be used to provide researchers, governments, administrators and policymakers with a better base to understand the health care system and its effect on health outcomes.

Social

- We live in a very mobile society (3). The mobility of Canadians puts a heavy demand on the health system to try to keep track of people's medical histories no matter where the patient is located when the health intervention is required. The adoption of interoperable EHR systems can ease this burden by making patient care information accessible on a need-to-know basis.

Technological developments

- Supporting technology is becoming more powerful and less expensive (3, 4). United Kingdom's Department of Health publication, *Information for Health: An Information Strategy for the Modern National Health Service 1998–2005,* states:

  Every year, developments in information technology bring rapid increasing processor power and greater storage capacity at ever reducing costs. Together with the increasing availability of IT systems as part of everyday working life, these developments mean that the Electronic Health Record is increasingly a possibility. The question is not "whether?" but "how soon?" (5)

  And, it might be added, "how?"

- Computers are becoming ever more acceptable in our everyday lives at work and at home (3). In fact, "physicians who are hospital-based will be early contributors to and users of electronic medical records, as these become an integral part of the health care system." Independent physicians "will likely be net retrievers of the information . . . " but for the reasons of privacy, cost and complexity "will probably not contribute much information from their own offices until a level of proficiency is established with regard to the issues of technology, standardization and security." (6) Either way, hospital-based or independent physicians will need to become familiar with technology and become users.

- The interface between users and systems is becoming less onerous due to advancements in technology. For example, a Smart Card that retains a patient's vital medical information could be retrievable by a physician by simply swiping the card through a reader and entering the appropriate security information. The card could become the link to the patient's full medical information stored in a database on an external Web server. Another example of technology is the use of portable computer notepads that enable nurses to directly capture patient health information. This would allow nursing staff to respond to questions that appear on the notepad screen by simply touching the appropriate part of the screen with a specialized pen, resulting in data being captured faster and easier, and thereby providing nurses with more time to spend with patients.

Despite the presence of these and other factors, the adoption of EHRs will be challenging. Many barriers and issues exist that will need to be considered if the move toward EHRs is to be successful. These barriers and issues are discussed in Section 10 of this document.

DEFINITION OF AN ELECTRONIC HEALTH RECORD

In researching this paper, it became very evident that there are many definitions of an EHR. Appendix A lists several definitions from various publications and related documents. An analysis of the definitions contained in Appendix A was conducted in order to develop a proposed definition for discussion purposes. This resulted in the following series of definitions that build on each other in a linear progression, introducing various concepts as required.

Incident Record: Selected data generated each time an individual interacts with a health care professional. One record is created for each interaction. For example, a record would be created when a physician prescribes a drug for a patient; another record would be generated by a pharmacist when the patient has the prescription filled. Relevant medical and administrative information would be included in all of the records.

Patient Record: A series of incident records for an individual that is generated by a specific health provider (e.g. a physician or a hospital). Each provider generates one series of records.

Health Record: All patient records that are generated over an individual's lifetime by all the health care providers who provided services to that individual. There may be many series of records for an individual.

Electronic Incident Record: An incident record that has been entered into an automated provider-based system.

Electronic Patient Record: A complete patient record accessible from a single, automated provider-based system (e.g. a physician's or hospital's system.)

Electronic Health Record: The health record of an individual that is accessible online from many separate, interoperable automated systems within an electronic network.

To facilitate this functionality, the proposed EHR would require five components.

16. *Person Identifier:* A universal code that uniquely identifies each individual within the health system.

17. *Facility Identifier:* A universal code that uniquely identifies each institution or centre that provides services within the health system.

18. *Provider Identifier:* A universal code that uniquely identifies each health care provider within the health system.

19. *Health Information:* Health data in a standardized format (e.g. diagnosis, x-rays, prescriptions) that are the result of interactions between individuals and their health care providers.

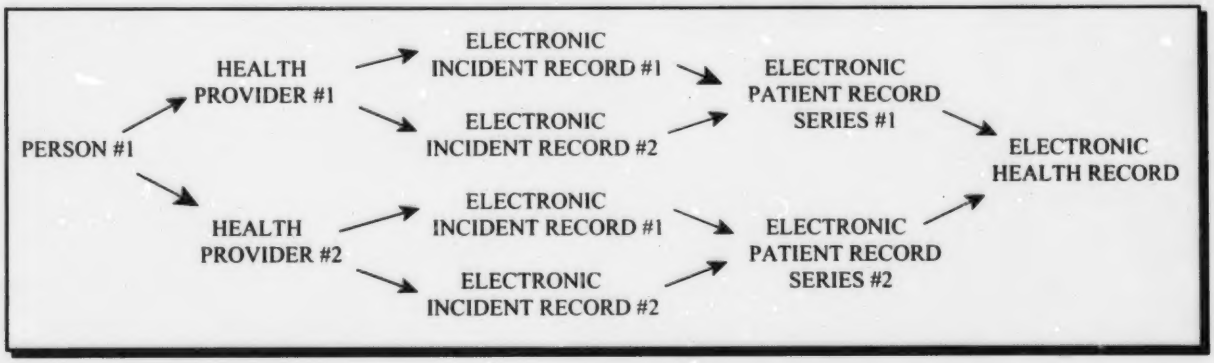
20. *Administrative Information:* Standardized data that support administrative functions, such as billing.

In addition to the above-mentioned identifiers, there has been some discussion around the inclusion of a device identifier. It would be used to identify major medical devices (e.g. EMRs, x-rays) for audit and evaluation purposes. This would, for example, give health care providers the ability to trace patients who may have been affected by a device. As this item is still under discussion, it has not been included in the list of components at this time.

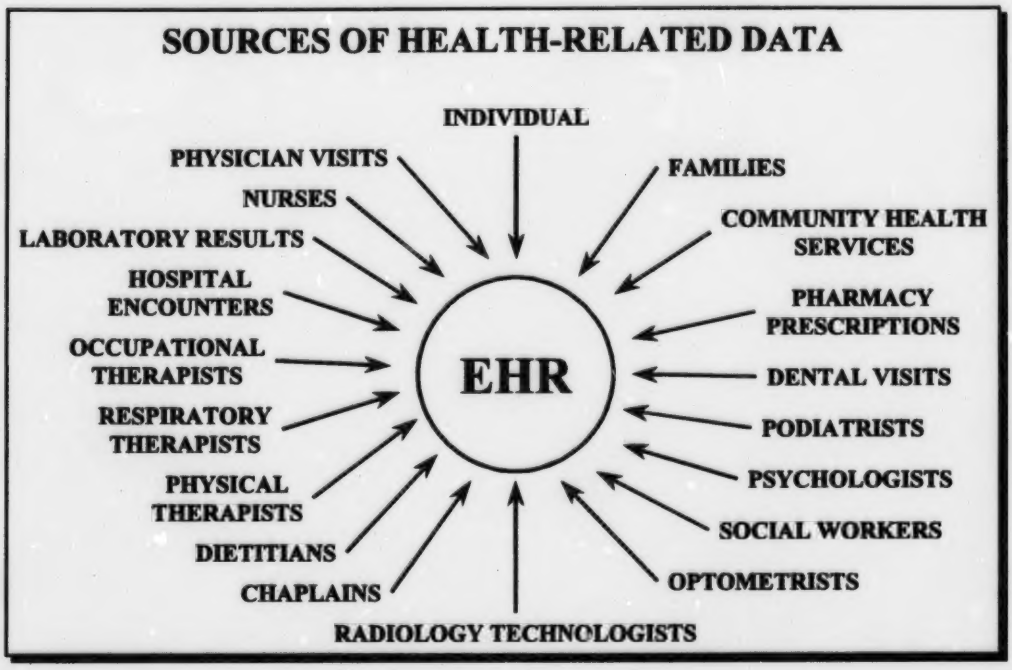
It is understood that privacy legislation and security standards must be in place to ensure that electronic records and the information they contain are protected.

The following illustrates the sequence of building the EHR.

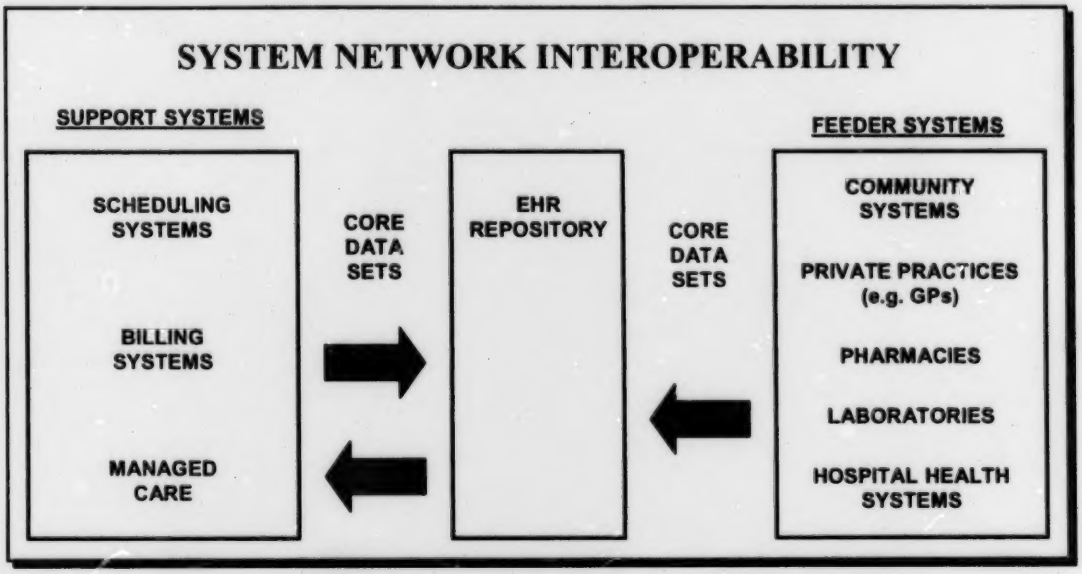
CREATION OF AN ELECTRONIC HEALTH RECORD



The previous diagram depicts an oversimplified view of the EHR. To gain a more accurate appreciation of its complexity and breadth of information, one must recognize the wide range of health information sources. Each time an individual visits a health care provider, data are generated. The following diagram identifies some of the sources of data for an EHR as listed by the Institute of Medicine (3).



Once the data have been collected, they are placed in many repositories or databases that are part of many health systems. From these systems, specific pieces of a patient's information are combined to create a core data set that is made available to other systems. The core data set includes health and administrative data. Its format must be agreed to by all stakeholders. The systems providing the information are referred to as feeder systems (e.g. laboratory systems). Other systems that use the data are called support systems (e.g. billing systems). To provide a comprehensive EHR, these systems must be linked, thereby allowing access to patient data regardless of their physical location. This introduces another level of complexity—system interoperability. The following diagram depicts the relationship of these systems.


SYSTEM NETWORK INTEROPERABILITY
SUPPORT SYSTEMS
SCHEDULING SYSTEMS
BILLING SYSTEMS
MANAGED CARE
CORE DATA SETS
EHR REPOSITORY
CORE DATA SETS
FEEDER SYSTEMS
COMMUNITY SYSTEMS
PRIVATE PRACTICES (e.g. GPs)
PHARMACIES
LABORATORIES
HOSPITAL HEALTH SYSTEMS

CONCEPTUAL OVERVIEW OF AN ELECTRONIC HEALTH RECORD SYSTEM

In 1997, the Institute of Medicine (IOM) (3) prepared a report that has become the "most comprehensive study ever undertaken on this topic and has become the seminal document for creating a road map to steer the nation towards routine use of EHRs." (7) To this end, the IOM proposed the following 12 attributes or features as benchmarks against which the progress of EHRs and EHR systems could be measured. These features are further supported by the Computer-based Patient Record Institute in the United States.

1. The EHR contains a *problem list* that clearly delineates the patient's clinical problems and the current status of each.

2. The EHR encourages and supports the *systematic measurement and recording of the patient's health status and functional level* to promote more precise and routine assessment of the outcomes of patient care.

3. The EHR states the logical basis for all diagnoses or conclusions as a means of documenting the *clinical rationale for decisions* about the management of the patient's care.

4. The EHR can be *linked with other clinical records of a patient*—from various settings and time periods—to provide a longitudinal (i.e. lifelong) record of events that may have influenced a person's health.

5. The EHR system addresses *patient data confidentiality* comprehensively—particularly ensuring that the EHR is accessible only to authorized individuals.

6. The EHR is *accessible for use in a timely way* at any or all times by authorized individuals involved in direct patient care.

7. The EHR system allows *selective retrieval and formatting* of information by users.

8. The EHR system can be *linked to both local and remote databases* of knowledge, literature and bibliography or administrative databases and systems so that such information is readily available to assist practitioners in decision making.

9. The EHR can assist and, in some instances, guide the process of *clinical problem solving* by providing clinicians with decision analysis tools, clinical reminders, prognostic risk assessment and other clinical aids.

10. The EHR supports structured data collection and stores information using a *defined vocabulary*. It adequately supports direct data entry by practitioners.

11. The EHR can help individual practitioners and health care provider institutions *manage and evaluate the quality and costs of care.*

12. The EHR is sufficiently *flexible and expandable* to support not only today's basic information needs but also the evolving needs of each clinical specialty and sub-specialty.

According to authors Andrew and Dick (8), there are at least five key underpinnings that are critical for meeting all 12 of the above IOM criteria. These underpinnings include:

1. a clinical data dictionary;

2. a clinical data repository;

3. flexible input capabilities;

4. ergonomically designed data presentation; and

5. automated support.

Andrew and Dick also note that the development of a technical infrastructure is further along than the necessary policies and definitions. The reason given for this inequality is that it is easier to address the "technical pieces" than to win the provider consensus needed on infostructure issues such as protocols and definitions. (9)

Although many EHR initiatives are under way in the Untied States, none has incorporated all of the above attributes. A report prepared for the U.S. Department of Defense Military Health Services System stated: "Although many organizations have successfully integrated several of these criteria into their systems, no fully designed and developed computer-based patient record exists that meets all of the IOM criteria." (7)

Section 5 described an EHR and its components and introduced a high-level view of the interconnected environment in which it will reside. This section presents a simplified conceptual view of the creation, uses and considerations affecting an EHR. As a simplified conceptual model, it does not show the complexities (e.g. range of health care professionals, volumes of data or the implications of legacy systems) inherent in building a technology infrastructure.

The following diagram of the conceptual overview is divided into two major sections: the left side depicts the components involved in the *creation* of an EHR, and the right side identifies the users and tools required to *access* the Network.

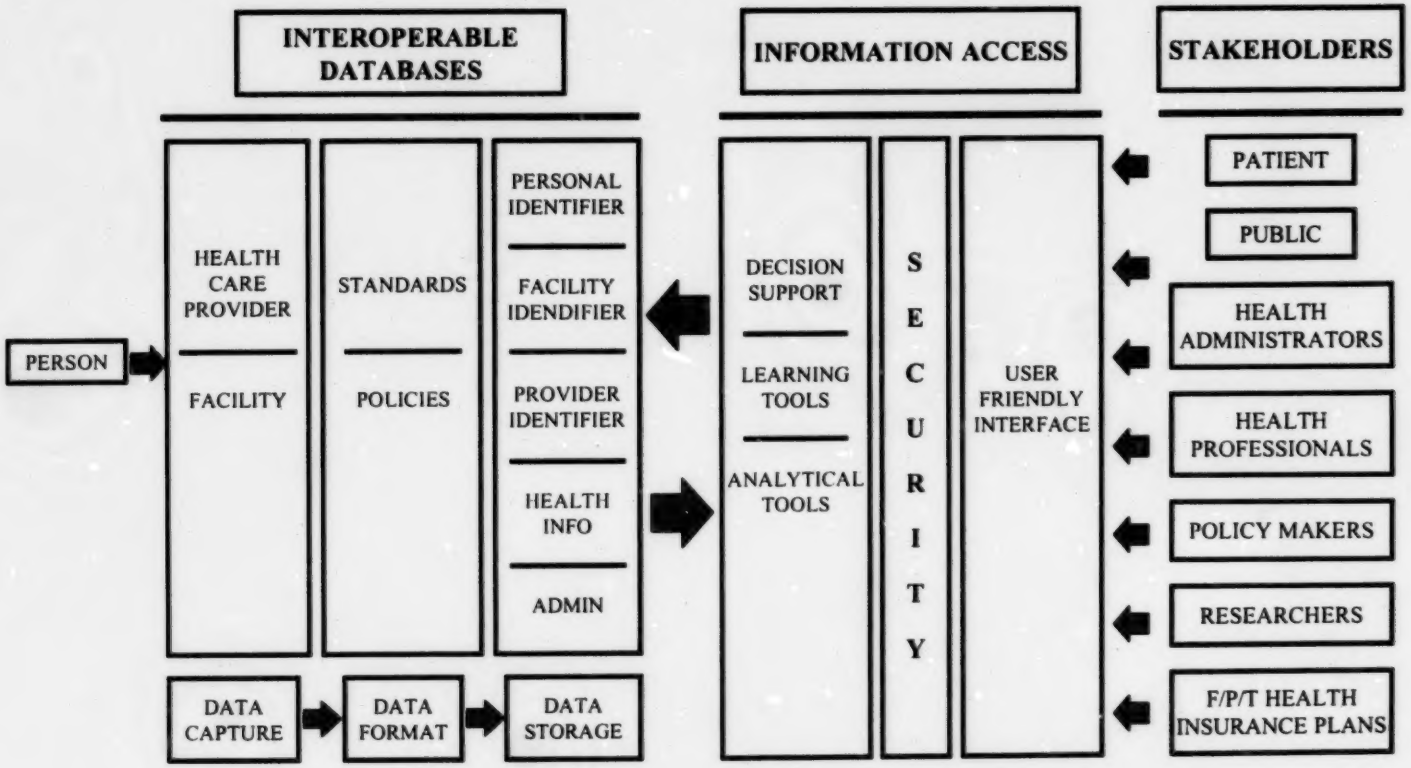
The creation of the Health Network (left side) involves the interaction of a person with a health care provider or health facility. The data are captured, subjected to standards and policies, and will then be stored with identifiers (person, facility and provider) as well as health and administrative data in interoperable databases.

The right side of the Health Network illustrates how various stakeholders access the data stored in the databases by using user-friendly interfaces, security levels (to protect privacy and confidentiality) and various tools.

In other words, once the requirements of an EHR are identified, an infostructure is required within which the EHR system will function. As previously stated, the EHR contains all health information generated by all the health care providers an individual interacts with over that person's lifetime. Each interaction will result in an Incident Record that will reside in a system. When these systems become interoperable, the building of the health infostructure begins.

ELECTRONIC HEALTH RECORD SYSTEM

CONCEPTUAL OVERVIEW



IMPLEMENTATION APPROACHES

Approaches to implementing EHR systems could be "revolutionary" (major change) or "evolutionary" (incremental change). Examples of implementation strategies for the United Kingdom, the United States and selected Canadian provinces are shown in Appendix B. It seems that most jurisdictions are taking an evolutionary approach from either a service perspective (e.g. pharmaceutical information networks) or an application perspective (e.g. Smart Card technology).

From the examples of implementation strategies shown, it can be seen that implementation of health infostructure initiatives is very complex, resulting in long-term and expensive projects. These approaches represent only a part of the overall puzzle of implementing a total health care solution. For example, the United Kingdom is investing £1 billion (approximately Cdn$2.5 billion) over seven years for the National Health Service (NHS) Health Information Strategy toward clinical solutions. Ontario will invest $550 to $700 million over the first three years of its Smart Systems project on Emergency Health Records and some infrastructure projects (e.g. Public Key Infrastructure [PKI], network and Smart Card technology).

Provinces and territories are taking different approaches to implementing EHR systems. At the local/regional level, EHR initiatives in Canada are most likely to be driven by hospitals and their needs. Such local initiatives are not always coordinated at the provincial/territorial level, and across Canada there is considerable possibility that systems will be implemented that cannot electronically communicate with each other. Another approach is a provincial/territorial-wide strategy to establish direction for each jurisdiction's initiatives.

In the United States, the IOM has identified eight critical activities that will help develop EHRs and EHR systems.

1. identification and understanding of EHR design requirements;
2. development of standards;
3. EHR and EHR system research and development;
4. demonstrations of effectiveness, costs and benefits of EHR systems;
5. reduction of legal constraints for EHR uses and enhancements of legal protection for patients;
6. coordination of resources and support for EHR development and diffusion;
7. coordination of information and resources for secondary patient record databases; and

8. education and training of developers and users.

One implementation example is from the University Health Network (UHN) in Ontario. (10) It currently has infrastructure and systems to manage administrative data, process admissions, discharges and transfers; support departmental operations; and enter orders and report results for most tests. The current environment combines paper and electronic media to store information that is critical to the provision of patient care. Its Project 2003 will move the organization to a comprehensive EPR. The first phase is a four-year plan with a total investment of $31.2 million allocated to the project.

The project strategy identifies four project groupings over the multi-year time frame:

1. document management projects;

2. clinical practice support projects;

3. integration projects to interact with external entities such as physician offices, Community Care Access Centres (CCAC) and other hospitals; and

4. research projects, clinical and outcome assessments, and clinical trials.

In 1991, the Kaiser Permanente Rocky Mountain Division, initiated an EHR project that encompassed 25 facilities and 350 000 members. (11) It had also established four target goals for the project:

1. making clinical patient information available to caregivers at any time or location without chart lockout;

2. creating a complete central data repository of clinical data for examination of relationships between interventions and outcomes;

3. automating care processes, thereby improving efficiency and reducing costs; and

4. providing effective methods of clinical decision support to positively influence medical decision making.

The initial planned time line for the project was 27 months; however, it is currently in its fifth year. System developers were placed into the medical working environment to gain a solid understanding of cultural change, process re-engineering and the challenges faced by medical staff and patients. This not only resulted in a sound understanding but also led to the identification of 60 major EHR requirements, which resulted in the longer project time frame. Additional details are contained in Appendix E.

BENEFITS OF AN ELECTRONIC HEALTH RECORD

The following lists the expected benefits of the implementation of EHRs:

- support patient care and improve its quality;
- enhance productivity of health care professionals and reduce the administrative costs associated with health care delivery and financing;
- support clinical and health service research;
- accommodate future developments in health care technology, policy, management and finance; and
- ensure patient data confidentiality at all times. (3)

The expectation of these benefits is also recognized by the U.K.'s *Information for Health: An Information Strategy for the Modern NHS 1998–2005*. (5) In electronic form,

> *. . . records are more likely to be legible, accurate, safe, secure, and available when required, and they can be readily and rapidly retrieved and communicated. They better integrate the latest information about a patient's care, for example from different "departmental" clinical systems in a hospital. In addition, they can be more readily analysed for audit, research and quality assurance purposes.*

The EHR is of pivotal importance to an integrated health care delivery system. To support this system, benefits must be realized by the stakeholders within that structure. The following table summarizes some of the potential benefits to those stakeholders.

STAKEHOLDER BENEFITS TABLE

STAKEHOLDERS	POTENTIAL BENEFITS
Public	• expanded reach of effective health care • more secure information • improved sense of well-being • access to information about how the health care system works
Patients or their representatives (i.e. child representing elderly parent or parent representing child)	• improved health care and decreased risks (e.g. adverse drug reactions) • integrated health services • do not have to repeat basic information, such as name, address • increased confidence knowing that all health care professionals have access to all relevant parts of their medical history • access to their own health records helps patients to make informed decisions about their health • avoidance of duplicate, invasive and/or expensive tests • reduced waiting lists
Health professionals	• integrated view of patient data • increased access to other related and integrated patient information • improved access through a portal to related health services • improved decisions with up-to-date patient information on an as-needed basis • improved seamless care through the coordination of multi-professional and multi-agency care • improved development of decision support systems
Health administrators	• increased patient care time • access to data to support clinical governance and local planning • reduced health care costs • improved health care quality
Policymakers (including governments)	• improves effective health maintenance and education • supports medical and administrative decision-making processes • provides for improved long-term planning
Researchers (including governments)	• access to timely high-quality data for research • access to up-to-date research findings, treatment and medication options • improved data quality • access to aggregate data • allows for improved trend analysis
Governments	• improved accountability • improved health resource allocation

Another group that will benefit, but which is outside the national health care structure addressed by this report, is private insurers of health care. For example, the Mutual Insurance Company of America (MICOA) "considers the electronic record so valuable that it offers discounts" to clinicians "if they document in a computerized patient record." (12) MICOA feels that EHRs will provide an accurate patient history, thereby reducing the chance of a successful malpractice suit. Although this is an American perspective, and fully understanding that the Canadian health care system is mainly public, it illustrates how EHRs are seen as important tools for privately managed health systems.

As a result of its Project 2003, Ontario's UHN has identified four areas where benefits are expected to be realized. (10) The following chart identifies these benefits for each of the four phases of the project.

	DOCUMENT MANAGEMENT	CLINICAL PROCESS SUPPORT	INTEGRATION	RESEARCH
Quality of patient care	• Reduce time to access clinical information • Reduce processing and waiting time for orders and results	• Reduce ADEs by 30% • Reduce surgical infections by 10% • Improve compliance with practice guidelines • Access to medical references	• Ensure quality of care across the continuum of care • Provide access to clinical information outside UHN sites	• Reduce variations in clinical practice affecting quality of care • Facilitate research into outcomes
operational efficiency	• Reduce physical health record space by 80% • Eliminate 50% of health record functions	• Reduce repeated and unnecessary tests by 20% • Reduce tests with conflicting Rx by 30%	• Integrate scheduling and information sharing with CCACs and physician offices	• Reduce variations in clinical practice, minimizing use of non-efficacious treatment
design and coordination	• Improve workflow process • Improve communication between care providers	• Refine clinical practice protocols to reduce deviation from standards	• Coordination with external health care organizations • Increased overall role in patient care planning	• Development of standards of care and clinical guidelines
Annual savings	$2M	$12M	$0.5M	

Although it appears that all stakeholders may benefit from the implementation of EHRs, results cannot be fully evaluated until implementation is complete. To address this gap, research must be conducted to evaluate if the benefits will be achieved from EHR implementations for each of the stakeholder groups identified in the Stakeholder Benefits Table, as well as benefits from a societal perspective.

ELECTRONIC HEALTH RECORD – RELATED INITIATIVES

This section identifies various health infostructure–related projects that directly or indirectly affect or involve an EHR system.

A list of Canadian initiatives appears in Appendix C. Included are projects in the provinces and territories, such as HealthNet/BC, Alberta We//net and Ontario's Smart System. The Strategic Planning Working Group of the F/P/T Advisory Committee on Health Infostructure has completed a Current State Assessment of EHR-related initiatives in Canada. The report will be available on the OHIH Web site. Appendix C, List of Key Related Projects in Canada, is based on data gathered in the fall of 1999.

At the federal level, Health Canada has undertaken an initiative to implement the First Nations Health Information System. With its data collection, FNHIS provides management and reporting tools, a comprehensive, flexible and powerful platform for case management and evidence-based planning and decision making for Canadian Aboriginal people. In addition, the Health Care Coordination Initiative (HCCI), composed of several federal departments and agencies (including Health Canada, the RCMP, Correctional Service Canada, Department of National Defence and Veterans Affairs) with responsibilities for health care delivery to specific populations, has recognized the importance of a Canadian health infostructure. It supports the leadership role of Health Canada with regard to federal government health information needs and exchange with other jurisdictions, including health records and telehealth. Both the Department of National Defence and Correctional Service Canada are currently involved in the development of EHR systems.

Each province and territory has a health infrastructure for identification of all qualifying residents. In the case of Newfoundland, the implementation of these identifiers goes back to as early as 1969. (14) The provinces have "used these numbers solely for processing billing claims and authenticating health care eligibility. As health numbers are used to identify electronic patient records, problems of completeness and duplication of numbers will become just as acute as the current problem of policing eligibility." (14) In addition, some key projects are listed for each province in Appendix C.

As evidenced by the list in Appendix C, EHR-related initiatives are under way and each addresses a specific part of health care, primary, acute and community care. This is due to the different nature of each environment related to workflow, data collection and the nature of the clinical practice. For example, the Ontario Primary Care Network is a pilot project involving approximately 40 physicians and 300 000 patients with the purpose of providing continuity of care from a team of health care professionals through the sharing of a patient's medical history. Individual physicians are implementing office systems for not only the capture of patient information, but also to support office administration. Finally, community care providers are piloting projects to improve the delivery of services to their clientele.

The OHIH report *International Activities Toward Electronic Health Records: Unique Identification and PKI*[1] has identified a series of international activities that are listed in Appendix D. Three of these initiatives, Cardlink2, Diabcard and Trusthealth (15), are currently under way in several countries, including Italy, Ireland, France, Finland, Portugal, Greece, the Netherlands, Germany, Spain and Austria. Each project addresses the use of Smart Cards as portable electronic records. Trusthealth has also addressed security, digital signatures and confidentiality.

[1] Public Key Infrastructure (PKI) uses public keys for encryption and digital signatures to provide for confidentiality of information, authentication of actors, integrity of data, non-repudiation of actions, and access control. It consists of the entire set of policies, processes, server platform, software and work stations used for (the purpose of) administering certificates and keys.

BARRIERS AND ISSUES

While there is interest in the concept of EHRs for the Canadian health care system, there are several barriers and issues that have the potential to delay their adoption. This section identifies seven major barriers and issues.

Many players and many approaches

The multitude of health care providers and governance models will pose a challenge for implementing an EHR system. First, while the expansion of health care providers and services has been a factor behind the call for EHRs and improved sharing of health information, it also means that their implementation requires support from many stakeholders. An individual may now receive care from several physicians and other providers at once. Policies to govern the implementation and use of EHRs will therefore require the support of many different provider groups.

Second, there are many different governance structures of health care services across the country. In many provinces, the provision of most publicly funded health care services is overseen by a regional board. But some services are overseen at the provincial level, particularly physician services. In Ontario, most services are overseen at the provincial level, while others such as ambulance and public health are administered by local governments. This results in the creation of many levels of responsibility for the delivery of health care in Canada, with different provinces taking different approaches. The issue now becomes the integration or compatibility of all of these processes and systems (if the processes are automated) into the network.

Management of the EHR

Related to the previous issue is the question of ownership or stewardship of the EHR. It may be assumed that provincial/territorial governments or regional boards will administer the EHR, but if current health care trends continue, this assumption may be challenged. First, in many instances EHRs are being created at the institutional level—within hospitals or between hospitals and medical clinics. In most cases, these systems are largely funded by the institutions themselves. Second, a growing percentage of health services are being provided outside the publicly funded or government-financed system, either by private service providers or via private insurance. Prescription drugs constitute a considerable portion of privately funded services. Third, there may be a move toward individuals either administering their own EHR or hiring the services of a third-party company to manage their EHR. For example, in the United States there are companies that will manage your EHR. The issue of linking these separate systems could be very problematic, thereby supporting the need for a coordinated national approach to EHRs.

Lack of a standardized EHR system

Since the EHR has the potential to be the cornerstone of a health information system, it is essential that a common understanding of EHRs is developed. Section 5 and Section 6 (Conceptual Overview diagram) list five major components of an EHR and their definitions. The barriers and issues associated with each component are listed in the following table.

COMPONENT	BARRIERS AND ISSUES
Person Identifier	• Lack of an interoperable code for each individual across Canada
Facility Identifier	• Lack of a unique code for each facility across Canada
Provider Identifier	• Lack of a unique code for all Canadian health care providers (e.g. physicians, nurses, pharmacists)
Health Information	• Lack of a common core set of elements that must be identified and agreed to in order to form the EHR and be consistent across the country • Many types and various sources of data (x-rays, CAT scans, MRI, text) • Lack of standards for coding structures • Numerous protocols for data access • Data changes over time (e.g. a five-year-old test may be in a different format than the current similar test) • Health care continuum of data—cradle to grave
Administrative Information	• Lack of national coding structures

In reviewing the need for standards, the Secretary of Health and Human Services (HHS) (15) in the United States has identified seven major subject areas that have resulted in 10 recommendations. The subject areas are:

- message format standards;
- medical terminologies;
- business case for patient medical record information standards;
- relationship to the national health information infrastructure;
- data quality, accountability and integrity;
- diverse laws and regulations; and
- privacy, confidentiality and security.

Lack of a health network architecture

The health care network will be composed of many systems, each addressing specific aspects of health care delivery, such as hospital services and provision of pharmaceuticals. A networked architecture will allow these systems to interact or talk to each other within a secure environment.

However, in establishing this network, a number of technical barriers and issues must be addressed:

- system interoperability (14) and an open-system architecture (16, 3);
- availability and cost of technology for remote regions;
- user-friendly access;
- communications security (PKI standards);
- rapid evolution of technology;
- current initiatives with proprietary hardware and software may limit EHR functionality;
- merging of legacy systems into the new architecture; and
- interaction with other networks (i.e. telehealth applications).

Lack of policies on key issues

While technological developments related to EHRs are moving rapidly, the development of key policies central to adopting EHRs has not kept pace. Until agreement is reached on such policy issues as privacy and liability, EHRs will face a slow and sometimes difficult implementation.

Privacy is the most important policy area that needs to be addressed in relation to EHRs. Without public support on how privacy will be addressed, EHR systems will not be able to proceed. Privacy involves the right of individuals to determine when, how and to what extent they share information about themselves and others. Survey after survey has found that Canadians are concerned about the loss of privacy in an electronic world. Some of the broad privacy issues relating to EHRs are as follows:

- What information should be included in the EHR? (Discussed above)

- Who should have access to the EHR? Which information in the EHR and under what circumstances should the EHR be shared with other health providers? How will a patient be able to access his or her own EHR?

- In what instances can the information in an EHR be used for secondary purposes (e.g. research, administration)? When is consent from the patient required?

Most provinces and territories are attempting to address health information privacy and a few have introduced health privacy legislation. It will be essential that federal/provincial/territorial governments develop compatible policy responses to the above questions to ensure public confidence in the adoption of EHRs and interoperable EHR systems. The Privacy Working Group of the F/P/T Advisory Committee on Health Infostructure has begun drafting an approach to harmonization. The recently adopted *Personal Information Protection and Electronic Documents Act* (formerly known as Bill C-6) will impact the privacy agenda for the next few years as provinces and territories ensure that their own regimes are consistent with federal legislation.

Adopting solutions developed by other countries will be very difficult not only due to the complexity of the Canadian health system, but also to international approaches to privacy and the resultant impact on their solution products. For example, health care is often delivered by private companies (i.e. Health Maintenance Organizations) which do not have to share their data.

The adoption of EHRs will add a dimension to the existing issue of liability for health care providers. The issue here is, who is responsible for the EHR, particularly when it consists of information from several sources? For example, who is liable for treatment errors based on incorrect information input by another provider? As well, who is liable in the event of a system or network failure, and when patient information is not available? The issue of liability will by no means prevent the adoption of EHRs, but greater education and awareness by providers on their responsibilities will facilitate the implementation of EHRs (16).

Obtaining stakeholder support

As already noted, numerous stakeholders are involved in the development of EHRs. Buy-in from all stakeholders (the public, health care providers and governments) will be essential for successful adoption of EHRs.

For EHRs to be endorsed by the public, it will be essential that their primary function be to improve patient care. Yet, there is still a lack of understanding and substantive studies about EHRs and their benefits. Health Canada has received a number of letters from Canadians who believe EHRs involve making their health records available over the Internet. As the Advisory Council on Health Infostructure recommended, there is a need for governments and other stakeholders to participate in awareness initiatives to assist the public to better understand EHRs.

The benefits of EHRs must not only be clear to the public but also to health care providers. While many health care providers express support for the concept of EHRs, considerable attention must be given to how new technologies will change health care delivery and existing provider inter-relationships, and to what the necessary conditions are to ensure successful adoption by providers. A good illustration of the first point can be seen in the growing use of the Internet as a source of health information. The patient–physician relationship is changing as individuals rely less on their physician as their only source for health information. Similarly, the use of EHRs will provide more opportunities for sharing information among health care teams; this may be seen as a threat by those providers who have traditionally controlled the flow of information. An understanding of these dynamics is necessary to identify strategies for effective implementation of EHRs.

From a social perspective, it will be important to ensure that the architecture that is implemented will be accepted by all health care providers and users. To successfully implement the architecture, users will need the required training in order to understand, accept and adopt the EHR and the technology, as well as be willing to use its features. A structured-change management approach is required to support implementation by bringing providers and users onside in the early stages.

Although EHRs are designed to allow for better sharing of health information, they must be accompanied by a shift in thinking by providers. We will be no further ahead if the technology is used to support the existing way of doing business.

Lack of leadership

There is a shared concern by most stakeholders that a lack of overall leadership—including national leadership—is resulting in the development of potentially incompatible systems. This point of view was expressed at a Telehealth and Multimedia Technologies conference in Edmonton in August 1999 and at the InfoHealth 99 Conference in Toronto in September 1999. Many EHR systems are being developed at the institutional level by hospitals that feel they can no longer wait for provincial direction. Strong leadership, beginning with funding, will be required if the objective is to have comprehensive EHR systems and interoperable networks. In particular, governments will need to be leaders in implementing EHR systems and other health infostructure initiatives, despite public and media pressures to address more traditional issues such as hospital bed and physician shortages.

Government leadership does not necessarily mean setting direction on all fronts. Instead, governments may have to clearly identify a suitable and realistic role for themselves in the development of EHRs. Options for action could include setting core data elements for EHRs, establishing unique patient and provider identifiers, developing standards and supporting research and analyses.

LESSONS LEARNED

In continuing to conduct EHR-related activities, it is important to build on lessons learned from other organizations. The following examples may serve as input into future activities.

The IOM states that the success of EHRs depends on the following conditions being met:

- users must have confidence in the data;
- users must use the record actively in the clinical process;
- users must understand that the record is a resource for use beyond patient care; and
- users must be proficient in future computer-based record systems and tools. (3)

In its own strategic approach to EHRs, the NHS in the United Kingdom offers the following observations:

> *For the strategy to be delivered effectively at the national level, we need highly motivated, well led, fully coordinated partnership arrangements in relation to four key processes:*
>
> 1. *Stakeholder input*
> 2. *Policy development*
> 3. *National program management*
> 4. *Performance management.* (5)

The American authors of *Aspects of the Computer-based Patient Record* identified three key lessons related to EHR systems. (17) These lessons revolve around data, its complexity, storage and usages.

The first key lesson addresses the complexity of data items and linkages: "Medical databases, which must service complex real world settings, are more complicated than databases for other domains."

The second key lesson identifies the need for redundant data storage: "A medical information system . . . requires multiple integrated structures. The longitudinal record can be kept to a manageable size by archiving supplemental databases independently."

And the third key lesson identifies overlapping user requirements:

> *Analysis of the information management requirements of the health care delivery constituencies indicates substantial overlap in need between user groups. The participants in the health care delivery process can be roughly divided into three user groups for the purpose of analysing their information management needs:*
> - *individuals with administrative responsibilities. . .*
> - *individuals working in ancillary service departments such as laboratory or pharmacy*
> - *direct care providers . . . .* (17)

Since 1995, the Computer-based Patient Record Institute has been recognizing health organizations and the lessons learned from successful implementations of computer-based patient records. Since its inception, nine organizations have been recognized by receiving the Nicholas E. Davies Award.

The following is a list of critical success factors (18) identified by the Awards Committee from reviewing all applications and especially the award winners.

CATEGORY	DETAILS
Management	addresses: strategy, leadership, buy-in and implementation
Functionality	defined by data captured and the assistance it provides in supporting patient care, management and other processes
Technology	provides the ability to meet user functional needs, system reliability and response time, and the flexibility to evolve
Impact	an assessment of the impact on patient care and business processes

APPENDIX A – DEFINITIONS OF ELECTRONIC PATIENT RECORDS

Health Canada, Advisory Council on Health Infostructure
The Advisory Council's final report, *Canada Health Infoway, Paths to Better Health*, provides this definition: "*Person-specific information* in provincial and territorial administrative systems should—in the context of *effective privacy legislation* and *stringent security safeguards*—provide a basis for creating the information resources for *accountability* and *continuous feedback* on factors affecting the health of Canadians." (1)

United Kingdom, National Health Service
The British National Health Services (NHS) initiative felt a need to differentiate between an "electronic patient record" and an "electronic health record." The NHS addresses *the individual healthcare occurrence* as opposed to the occurrences *a person will experience throughout their life time*. Further,

> [The] *electronic patient record* describes the record of the *periodic care provided mainly by one institution*. Typically, this will relate to the healthcare provided to a patient by an acute hospital. EHRs may also be held by other healthcare providers . . .
>
> [The] *electronic health record* is used to describe *the concept of a longitudinal record of patient's health and healthcare—from cradle to grave* . . . . In theory the EHR is therefore a combination of the bulk of the primary care EHR for a patient together with linking information from other record systems for that patient. (5)

Institute of Medicine, United States
In its 1997 publication, *Computer-Based Patient Records*, the Institute of Medicine (IOM) offers a series of definitions to represent various views of patient data.

> A *patient record* is the repository of *information about a single patient*.
>
> A *computer-based patient record* (CPR) is an *electronic patient record that resides in a system* specifically designed to support users by *providing accessibility to complete and accurate data*, alerts, reminders, clinical decision support systems, links to medical knowledge and other aids.
>
> A *primary patient record* is used by health professionals while providing patient care services
> .
>
> A *secondary patient record* is derived from the primary record and *contains selected data elements* to aid non-clinical users . . . . in supporting, evaluating or advancing patient care.
>
> A *patient record system* is the set of components that form the mechanism by which patient records are created, used, stored and retrieved.

United States Department of Veterans Affairs
The Department of Veterans Affairs (DVA) offers two definitions.

- **Computer-based Patient Record:** *An electronic record stored in the Decentralized Hospital Computer Program . . . or any other automated system using an electronic storage system* (e.g. optical disk that provides easy retrievability of complete, accurate and timely medical information).

- **Consolidated Health Record (CHR):** The scope of the DVA medical record expands the traditional concept of a patient record by using a CHR. The VA CHR reflects the skills used by the professional and administrative specialists throughout the patient's period of health care. It may be maintained as a paper record or a computer-based patient record. The CHR can be called the medical record, the patient record, the health record and the computer-based patient record. The CHR usually contains two divisions which are:

  1. *Medical Record:* An official record documenting the diagnosis, treatment or care of a patient.

  2. *Administrative Record:* An official record pertaining to the administrative aspects of the care of a patient.

Journal of the American Medical Informatics Association (20)
The Association's *Position Paper: A Proposal to Improve Quality, Increase Efficiency, and Expand Access in the US Health Care System* identifies four types of computer-based health records:

1. for *health care institutions* (such as hospitals) and delivery systems;

2. for *primary care* and a variety of ambulatory care uses;

3. for personal health records *for individual use*, including assessment of health status; and

4. computer-based population records *for monitoring public health* and the outcomes of care.

APPENDIX B – EHR-RELATED SYSTEM IMPLEMENTATION STRATEGIES

UK	NFLD	ONTARIO	ALBERTA	BRITISH COLUMBIA (22)	INSTITUTE OF MEDICINE (3)
Clinical Administration Data • Patient administration and independent departmental systems	Unique Personal Identifier	Emergency Health Record	Breast Cancer Screening	Telecommunications Network for Pharmacies and Hospitals	Adoption of EHRS as the standard for medical records
Integrated Clinical Diagnosis and Treatment Support - integrated master patient index, departmental systems	Personal Medication Dispensing History	Identification and Security	Common opportunities - continuing care and public health - administrative, clinical and financial systems	PharmaNet implementation - emergency department pilot	Creation of an EHR implementation group
Clinical Activity Support - electronic clinical orders, results reporting, prescribing, multi-professional care pathways	Personal Diagnostic Service History	Public Key Infrastructure	Drug Profile	E-mail Secure File Transfer	Support implementation through research and development projects
Clinical Knowledge and Decision Support - electronic access to knowledge base, embedded guidelines, rules, electronic alerts, expert systems	Diagnostic Service Requester Decision Support	Virtual Private Network	Integrated Cancer Care Network	Continuing Care Pilot	Creation of national standards for data and security
Specialty Specific Support - special clinical modules, document imaging	Personal Medication Regimen	Secure E-mail	Laboratory Test Ordering and Results	Health Registry	Implementation of appropriate legislation and regulations
Advanced Multimedia and Telematics - telemedicine, other multimedia applications (i.e. pictures, archiving)	Personal Health Information Profile	Smart Card Technology	Newborn Metabolic Screening	Public Key Infrastructure	Costs of EHR systems to be shared by those who benefit from EHR
	Physician Practice Pattern Profiling	Health Data and Technology Standards	Pharmaceutical Information Network	Full HL7/HNSecure Implementation	Enhance education of health care providers in EHR and related technologies
	Clinician Decision Support Tools		Physician Office Systems		
			SPHINX		
			Telehealth		
Estimated Cost: £1 billion pounds, Approx. Cdn$2.5 billion	$10 million	$550–$700 million	$90 million		
Estimated time frame: 7 years	5+ years	first 3 years	3 years		10 years

APPENDIX C: LIST OF KEY RELATED PROJECTS IN CANADA

LOCATION	PROJECT NAME	PROJECT GOALS	TIME LINE
Newfoundland	Community Health Information Management Project (21)	Implement an information management project for all community health offices (21)	4 years, starting April 1997 (21)
	Newfoundland and Labrador Centre for Health Information (2)	Combine health information systems to establish an integrated and comprehensive IT system (21)	February 1998 (21)
Prince Edward Island	Island Health Information System (21)	Provide support for service delivery processes, links between care providers, information on patient care, planning, evaluation and research (21)	Health care sites connected since 1995 (2)
	Pharmaceuticals Informatics Program (21)	Electronically link retail pharmacies, physician offices, hospital emergency rooms and pharmacies and the IHIS (above) (21)	Fall 1997 launch for pharmacies (21)
Nova Scotia		Automated communication of laboratory test (2)	Evaluation March 1999 (2)
New Brunswick	Wellness Network (21)	Establish a private and secure communications network to service the health industry (22)	Commenced 1992, all hospitals online and 15% of physicians are using the system (21)
Quebec	Inforoute Santé (21) l'autoroute de l'information (2)	Use IT to provide access to patient information and link a variety of stakeholders (21); plan to implement Smart Card technology (22)	1994–1998 (21)
Ontario	Smart System (2) (Primary Care Network)	Support and improve quality of health care delivery, health care planning and administration via a telecommunications network (21)	1995–1998 (21)
	Child Health Network (20)	Electronic Child Health Network links Toronto's Hospital for Sick Children with four other facilities (20)	
	HealthLink Clinical Data Network Corp.	Connects more than 40 health care organizations in Ontario	
	University Health Network	Project 2003, implementation of EHR	1999–2003
	St. Elizabeth Health Care	Community care pilot project	
	Markham Stouffville Hospital	Acute care project with link between clinics and the hospital	
Manitoba	Manitoba Health Information Network (2)	Develop a network of secure and confidential information exchange between authorized health professionals (21)	Current pilot pharmacy system (2), completion 1995–2000 (21)
	Drug Programs Information Network (2)	Link retail pharmacies in the province for health safety and Pharmacare accounting purposes (21)	Operational by 1999 (2)

LOCATION	PROJECT NAME	PROJECT GOALS	TIME LINE
Saskatchewan	Saskatchewan Health Information Network (2)	Information management system built on the province's existing fibre-optic network (21)	Backbone operational Pilot EHR
	Provincial Immunization Record System (21)	Connect 30 districts and many First Nation health delivery agencies through a secure provincial immunization database (21)	Fall 1997 (21)
	Newborn Registration System (21)	Allow rapid assignment of a permanent identifier to the newborn (21)	N/A
Alberta	Alberta We//net (2)	Provide logical view of EHR with supporting person identifier (2); We//net links 17 newly created regional health authorities (22)	Pilot of personal health records started in 1999 (2)
British Columbia	HealthNet/BC (2)	Develop an open information-sharing network that allows multiple stakeholders to provide a wide variety of services to support health-related business needs (21); A network that allows all pharmacies to share prescription records (22)	Began in 1993 (21) Online health records part of long-term vision (2)
	BC Health Information Standards Council (21)	Advise the Ministry of Health on health information standards that should be adopted in the province (21)	Established 1995 (21) PHN - approved (21)
Yukon	Cornerstone (21)	Project focussing on intake and case management of generic models (21)	1995–1997 (21)
Northwest Territories	Welcom (2)	Distributed health care information database to provide encounter-based EHR (2)	By 2000–2001 (2)

Data extracted from:

- *Health Information Technology in Canada 97: A Review of Ongoing Initiatives*, Draft August 1997 (21)
- *Common Issues, Common Infrastructure: Securely Communicating Health Information Across Canada's Provinces and Territories*, November 1998 (13)
- OHIH *Briefing Note, Telehealth in Canada*, August 1999. Based on Exocom review, July 1999 (23)

APPENDIX D – LIST OF KEY RELATED INTERNATIONAL PROJECTS

These projects were extracted from the OHIH report *International Activities Toward Electronic Health Records: Unique Identification and PKI.* (14)

PROJECT	DESCRIPTION	COUNTRIES
CARDLINK2	Patient-held Smart Card medical record for application in cases of medical emergencies; allows access to hospital and primary care databases	Italy, Ireland, France, Finland, Portugal, Greece, the Netherlands, Germany and Spain
DIABCARD	Card-based chip (Smart Card) for chronic diseases in ambulatory and hospital care; serves as a portable electronic record; can be used as a stand-alone system or integrated into existing information systems and networking environments	Austria, France, Germany, Greece, Italy and Spain
TRUSTHEALTH	Developed key security specifications, including cryptographic techniques and Smart Cards for secure identification, digital signatures and confidentiality; includes the use of Healthcare Professional Cards that protect private keys and all portability to any PC	

COUNTRY	PROJECT	DESCRIPTION
G7 Project	G7 Global Healthcare Application Project	• Enabling technical and functional interoperability of the cards in participating countries
Germany	Versichertenkarte	• Issued 73 million cards containing administrative data (256 byte capacity). Project ended in 1995
	Patientenkarte	• Uses A-Card, storing patient history and drug information
	DIABCARD	
France	3-year strategy starting in 1996	• To distribute Smart Cards with administrative and medical information • To distribute health professional cards to health care providers for digital signatures, to access patient card information and to access the network • Create a health care Intranet
	Two types of patient cards have been issued	• Family card with administrative data • Personal card with administrative and health information
Finland	Patient card with fingerprint recognition, to be implemented fall 1999	• Card allows patients to access their information on the Internet with privacy protection provided by the fingerprint recognition on the card
United Kingdom	NHS number in use since June 1998	• Provide unique and unambiguous patient identification • 10-digit with the last being a validation digit • Several NHS health systems have installed the number

COUNTRY	PROJECT	DESCRIPTION
	IM&T Strategy	• Will result in a single, integrated lifetime patient record available 24 hours a day to every NHS organization
	NHS Phase I - 1998–2000	• Deliver strategic components
	NHS Phase II - 2000–2002	• Delivery of EHR and the incorporation of telemedicine in local programs and other key targets
Australia	Task Force on Quality in Australian Health Care	• Recommended feasibility and pilot studies into the introduction of a voluntary patient-held Smart Card. Five-year project, started in 1996
New Zealand	Health Information Strategy for the Year 2000	• The National Health Index maintains records of unique identifier, name, address and date of birth for the population
United States	Department of Health and Human Services	• Planning to publish a Notice of Intent to facilitate discussions about alternatives for a health identifier for individuals • Proposed rules for a National Provider Identifier published in May 1998 and were subject to public comments until July 1998
	Department of Veterans Affairs (DVA): Government Computer-based Patient Record Initiative	• Framework in place to develop a means of providing and protecting worldwide, lifelong medical records of military personnel; plans are to extend the framework to the civilian population at a later date
	DVA: Composite Health Care System II	• Provide worldwide health care information across 60 clinical information systems for military personnel

APPENDIX E: SUMMARY OF KEY EHR PAPERS

1. Overview of a national strategy for local implementation: National Health Service, *Information for Health: An Information Strategy for the Modern NHS 1998–2005.*

2. Summary of report: Kaiser Permanente Rocky Mountain Division, *Clinical Information System: Comprehensive Review*, 1998.

#1. OVERVIEW OF A NATIONAL STRATEGY FOR LOCAL IMPLEMENTATION: National Health Service, *Information for Health: An Information Strategy for the Modern NHS 1998–2005*

BACKGROUND

The National Health Service (NHS) of the United Kingdom has introduced a 10-year program to modernize the health system. In September 1998, the NHS published *Information for Health: An Information Strategy for the Modern NHS 1998–2005*. The document states:

> *The purpose of this information strategy is to ensure that information is used to help patients receive the best possible care. The strategy will enable NHS professionals to have the information they need both to provide that care and to play their part in improving the public's health. The strategy also aims to ensure that patients, carers [sic] and the public have the information necessary to make decisions about their own treatment and care, and to influence the shape of health services generally.* (5)

In modernizing the NHS, the government developed a vision that is:

- a national service;
- fast and convenient;
- of a uniformly high standard;
- designed around the needs of patients, not institutions;
- efficient, so that funds are spent to maximize the care of patients;
- making good use of technology and know-how; and
- tackling the causes of ill health as well as treating it.

To achieve this vision and to support the objectives, the strategy commits to:

- creating a lifelong EHR for every person in the country;
- providing around-the-clock, online access to patient records and information about best clinical practices for all NHS clinicians;

- providing genuinely seamless care for patients through physicians, hospitals and community services sharing information across the NHS information highway;
- providing fast and convenient public access to information and care through online information services and telemedicine; and
- promoting effective use of NHS resources by providing health planners and managers with the information they need.

In designing and developing the required systems, the following principles will be adhered to:

- information will be person-based;
- systems will be integrated;
- management information will be derived from operational systems;
- information will be secure and confidential; and
- information will be shared across the NHS.

IMPLEMENTATION

In developing an implementation strategy, the NHS recognized that the implementation must proceed at a reasonable pace in relation to the flow of resources and the sheer scale and complexity of the technical, cultural and management challenges that will be faced. Over the first seven years of this endeavour, the total investment will be in excess of £1 billion, or approximately Cdn$2.5 billion.

The NHS recognizes the present disparity in the level of information systems support to clinicians, and therefore set a minimum level of development across the acute sector. This resulted in the creation of a six-tier EHR, as illustrated in the following diagram.

EHR LEVEL HIERARCHY

Level	Features	Specialty and Department-Specific EPR Support	Hospital Analysis EPR	Primary/Community Secondary-Tertiary Care Interface
Level 6	Full Multimedia EPR Online • EPR & Shared EHR available across the community • EPR integrated with: - video and speech - clinical images (e.g. x-rays) - document images (e.g. text) - outputs from monitoring devices (e.g. ECGs)	**Advanced** • Critical/Intensive care with links to medical devices • PACS • Telemedicine • Document imaging of case notes	**Advanced** • Full hospital-wide data repository • Ability to link all types of patient data • Full patient costing	**Advanced** • Hospital EPR fully linked into primary care EHRs • Electronic referral linked to protocol and guidelines • Booking capability for GPs into agreed Secondary Care Clinics • Electronic link to LG Social Services Department • Shared care systems with electronic sharing of patient data • Technical support systems
Level 5	Advanced Clinical Documentation and Integration • Active Integrated Care Pathways (Phase 3) • Advanced Clinical Documentation • Integration of Clinical Processes & Documentation			
Level 4	Clinical Knowledge, Decision Support and Integrated Care Pathways • Interactive decision support (utilization of patient-specific data) • Guidelines and protocols • Viewing of evidence-based integrated care pathways (ICP's Phase 2) • Viewing information and knowledge (non-patient specific)	**Intermediate** • Shared care systems (e.g. diabetes, asthma, CHD, child health) • Specialty-specific support modules (e.g. renal, cardiology)	**Intermediate** • Casemix analysis • EIS style support	**Intermediate** • Some Edifact messaging into EHR • Hospital EPR Viewable by GPs • Referral Guidelines and Hospital Intranet viewable by GPs • Two-way electronic referrals/discharges between hospital and community clinicians
Level 3	Clinical Activity Support and Noting • Integrated care pathways (Phase 1) • Out-patient order entry, results reporting and prescribing • Electronic prescribing and medicines administration • In-patient order entry and results/report viewing • Clinician noting: single discipline • Clinical documents, correspondence viewable across hospital			

Level 2	Integrated Patient Administration and Departmental Systems • Common, shared MPI (Demographics) and interfaces with main departmental systems • Real-time admissions, discharges, transfers and bed management • Integrated PAS/clinical systems and clinical correspondence production • Discharge letter, OP Clinic letter, DNA letters, etc. • Clinical encoder interfaced with PAS • Basic results viewing on wards/other departments (e.g. laboratory, radiology)	**Basic** • pathology • radiology • pharmacy • A & E • theatres • maternity	**Basic** • Contracting support • Analysis of patient data restricted to CMDS view • Limited linkage of data from different systems • Stand-alone analysis systems common (e.g. Calman cancer)	**Basic** • NHSnet connectivity • E-mail/ASTM of patient information to GPs and community staff • NHS-wide Clearing Service • NHS Strategic Tracing Service • Community-wide MPI via organizational links
Level 1	Independent Patient Administration & Departmental Systems • Patient-administered systems • Departmental systems			

The following activities were seen as national priorities and milestones and, therefore, were planned to be completed within the first year.

- complete business case;
- complete implementation strategy, including an initial local implementation strategy;
- establish national partnership process;
- establish detailed funding arrangements for a national infrastructure;
- establish information policy group;
- define core regional office process, including a national template of deliverables;
- establish national body to address items or issues that are national in nature (e.g. core data set);
- establish standards for interoperability; and
- review plans for Phases 2 and 3, after 2005.

The following plan outlines the activities for an initial seven-year plan, from 1998 to 2005.

1998–2000	2000–2002	2002–2005
• Address Y2K problem • Develop and attain agreement on initial costing for local implementation strategies • Complete essential infrastructure • Connect all computerized GP practices to NHSnet • Offer NHS direct service to whole population • Complete national NHS E-mail project • Establish local Health Informatics Services • Complete cancer information strategy • Complete plans from beacon EHR sites	• 35% of acute hospitals to Level 3 • Substantial progress in implementing integrated primary care and community EPRs in 25% of Health Authorities • Use NHSnet for appointment books, referrals, radiology and laboratory requests/results in all parts of the country • Community prescribing with electronic links to GPs and the Prescription Pricing Authority • Telemedicine and telecare options considered routinely in all Health Improvement Programmes • National electronic library accessible through local Intranets in all NHS organizations • Complete information strategies to underpin completed National Services Framework • Beacon EHR sites have an initial first-generation EHR in operation	• Full implementation at primary care level of first-generation person-based EHR • All acute hospitals with level-3 EPR • Electronic transfer of patient records between GPs • 24-hour emergency care access to patient records

#2. SUMMARY OF REPORT: KAISER PERMANENTE ROCKY MOUNTAIN DIVISION

Clinical Information System: Comprehensive Review, 1998

In 1991, the Kaiser Foundation Health Plan and the Colorado Permanente Medical Group initiated the design, development and implementation of a comprehensive Clinical Information System (CIS) for its clinicians and members. The target goals were:

1. making clinical patient information available to caregivers at any time or location without chart lockout;

2. creating a complete central data repository for clinical data, allowing for examination of relationships between interventions and outcomes;

3. automating care processes, thereby improving efficiency and reducing costs; and

4. providing effective methods of clinical decision support to positively influence medical decision making.

The overall environment included 25 facilities:15 medical offices, 4 mental health offices, 3 administrative offices, 1 emergency department and 2 hospitals. The total population included approximately 500 physicians, 2 000 health plan staff and 100 medical student/resident physicians, who provide care for 350 000 members. The hardware base included 3 400 work stations, 175 printers, 32 servers and associated network components in a fully secure and confidential environment.

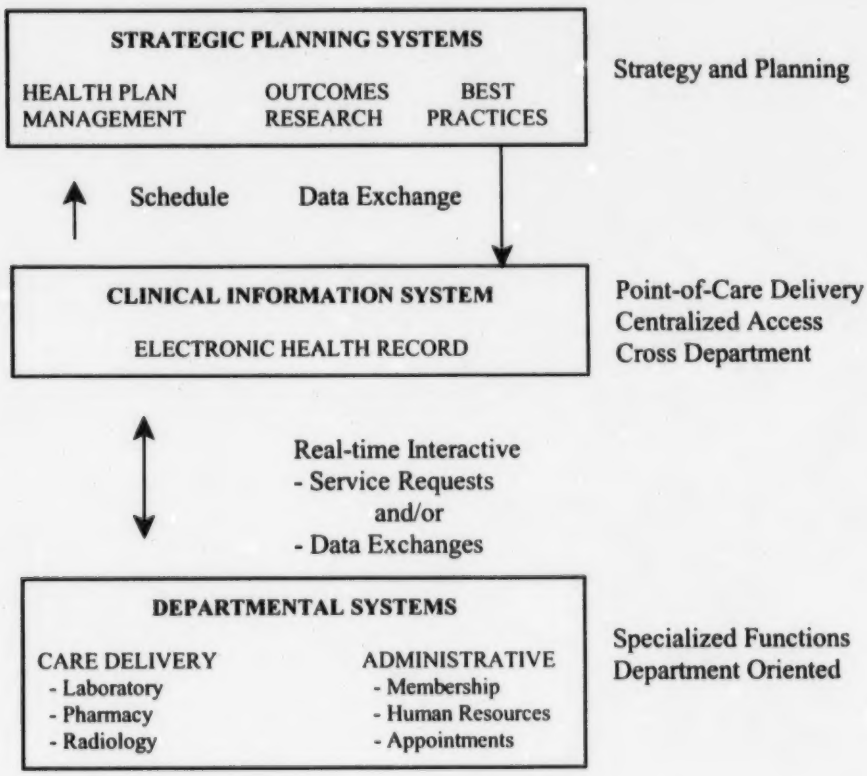
Originally planned as a 27-month project, it required over five years to go from initial design to complete full access implementation. Delay was largely due to increases in understanding of the depth of the requirements. Developers were immersed in the care environment in order to gain first-hand knowledge of the challenges faced by providers and patients. The result was the identification of 60 major requirements. The major capital cost expenditures were system development and PC acquisition. From an operational perspective, one third of the costs were related to training, the single highest cost. Although specific costs were not available, the report states that "without a system that accomplished the stated goals, care delivery would suffer greatly over time." (11) In addition, the CIS will be cost-effective from an operational perspective, but, more importantly, will become truly beneficial when it is used to manage clinical decisions.

The system facilitates rapid documentation of all aspects of care in any setting (clinical visits, phone contacts, specialty summaries, outside documents or files) that requires health care providers to take action only once, thereby reflecting that action in the pertinent part of the health record. This would provide convenience to the providers and improve quality of care for the patients. To support

the data capture and to ensure data integrity, timeliness and reliability, a lexicon of controlled medical terminology was developed to work in the background, allowing the system to convert the data into the appropriate codes.

The following diagram illustrates the enterprise view of the CIS application.

ENTERPRISE VIEW – APPLICATIONS



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